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Abstract

SAFETY ASPECTS OF U.S. EXPERIENCE IN SPENT FUEL PROCESSING

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Processing of irradiaced nuclear fuel presents, in addition to usual industrial safety hazards of fire, explosion, and personnel injury by mechanical and chemical means, two unique hazards: the waste products are highly toxic in minute quancities, and the principal product is fissionable. Millions of curies of radioactivity are handled routinely in highly mobile liquid or gaseous states in U. S. fuel reprocessing operations; the overall safety record has been excellent, personnel exposures have been very low, and contamination of the environment has been insignificant. In its overall safety record, the U. S. atomic energy industry ranks with the top U. S. industries; in a typical year, less than one-tenth per cent of USAEC-connected workers received a radiation dose at work exceeding that received in a complete dental X-ray, and none who exceeded this level received a serious dose. In a typical processing operation, the Idaho Chemical Processing Plant handles 1 3/4 million curies of activity per day; less than 2×10^3 per cent of this activity is released to the environment, most of it through the stack. A significant demonstration of containment of high-level particulate activity is to be found in the ICPP Waste Calcining Facility. The gaseous effluent from this plant, processing ICPP aluminum fuel waste since December, 1963, by fluidized bed calcination, has consistently had an activity approximately 0.2 per cent of that permitted by RCG limits.

Several factors contribute to the accomplishment of this record. Facilities are designed to insure adequate radiation protection of personnel and to provide secondary containment of radioactivity in event of difficulties

with process equipment. Processes are designed to provide essentially complete decontamination of all streams before their release to the environment and equipment is designed to provide positive containment of all radioactive streams; critically safe geometry or nuclear poisons are used where feasible. Active safety programs assure effective preplanning of procedures to avoid emergencies, of actions to restrict the magnitude of an emergency, and of actions immediately following an emergency to minimize effects; personnel training assures that employees in processing operations are thoroughly familiar with the plans and procedures; administrative followup assures that the overall program is accomplished effectively.

The overall safety record provides a measure of the effectiveness of these approaches. The few incidents which have occurred were encountered during abnormal or non-routine situations and the effects were confined to the accident area. Five nuclear criticality incidents have occurred in recent years. Two were in a plant processing irradiated fuels and resulted in no facility damage and no significant radiation exposures; three occurred during processing of unirradiated fuel materials and resulted in one fatality and some substantial radiation exposures. Non-nuclear incidents in chemical processing plants have included fires, chemical explosions, and spills of radioactivity in plant areas. Though less widely publicized than the criticality incidents, they indicate the need for continuing emphasis on ordinary chemical process safety. Analyses of these incidents have revealed problems in communication, operator performance, and safety training and have indicated areas in plant equipment where improved operational safety was needed. One result has been the development of more positive mechanisms of administrative safety control in the processing plants. Specific details of the systems vary from plant to plant, but all require (1) a clear definition of responsibilities for safety between the technical and the operations groups, (2) periodic management audits of performance, and (3) competent and thorough review of the safety aspects of proposed new facilities and facility modifications.